On polar/non-polar atmospheric linkages: observations and model diversity

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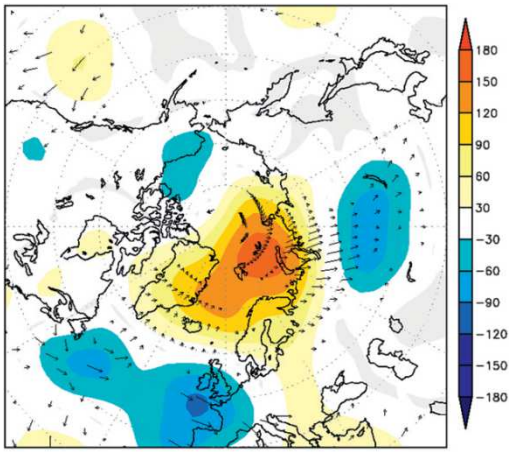
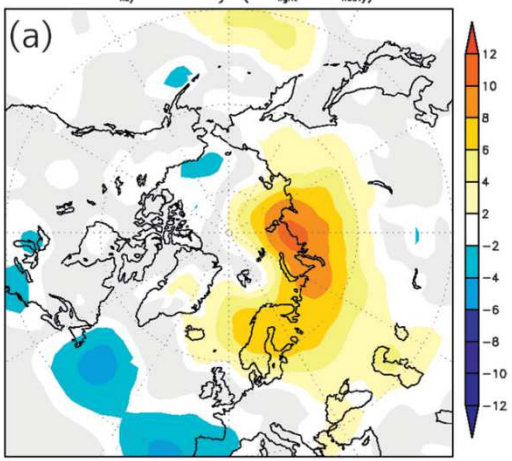
[MOD] A. Arribas (MetOffice), Y. Gao (NERSC/BCCR), V. Guemas (BSC, CNRM), M. P. King (URC/BCCR), D. Matei (MPI-M), R. Msadek (GFDL, CERFACS), W. Park (GEOMAR), E. Sanchez-Gomez (CERFACS)

EC-EARTH meeting 2016

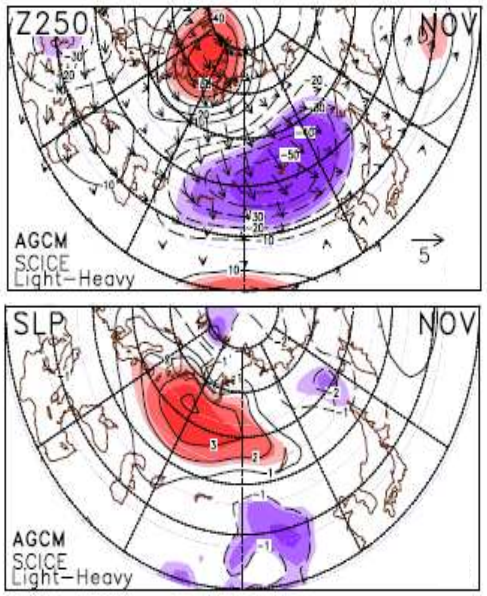
Z250 / WAF (DJF)



SLP_{key} anomaly ($Ice_{light} - Ice_{heavy}$)



Inoue et al. (2012, GRL)

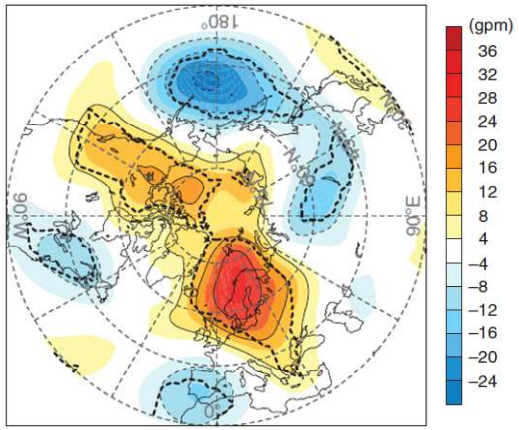


Honda et al. (2009, GRL)

might be non-linear to SIC reduction!

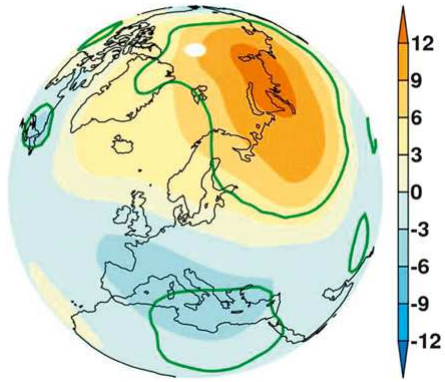
Petoukhov and Semenov (2010, JGR)

ΔZ500 for ND, CAM5



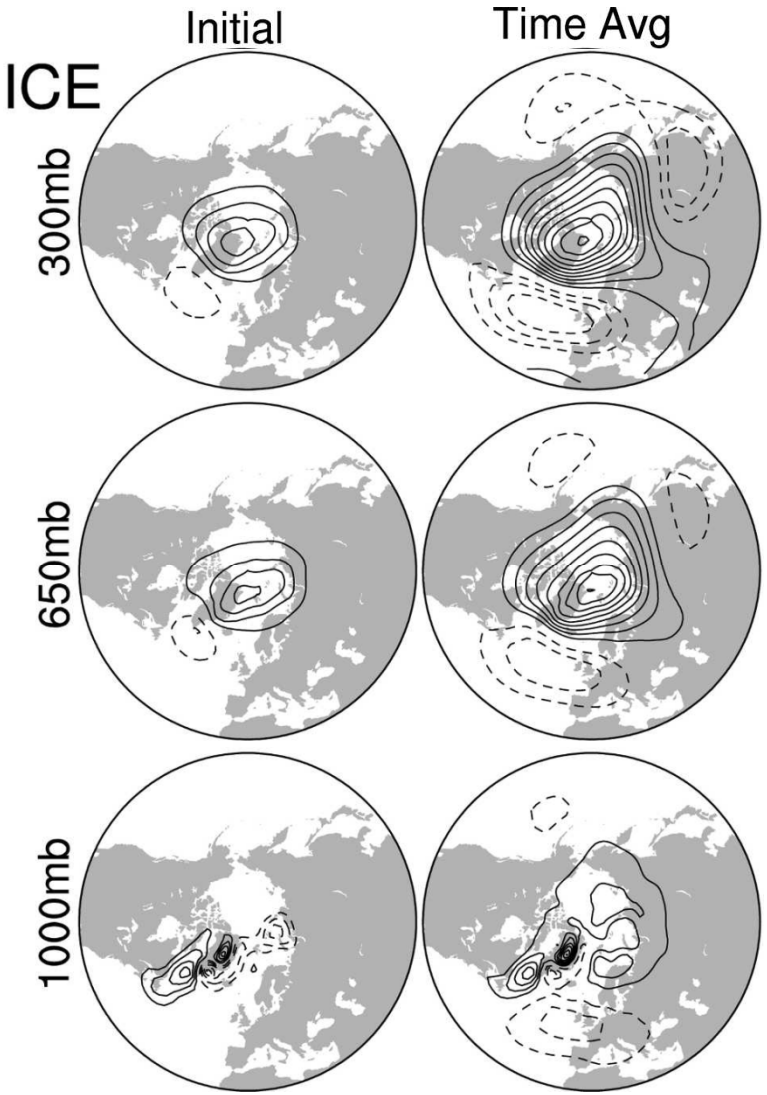
Kim et al. (2014, Nat.Comms)

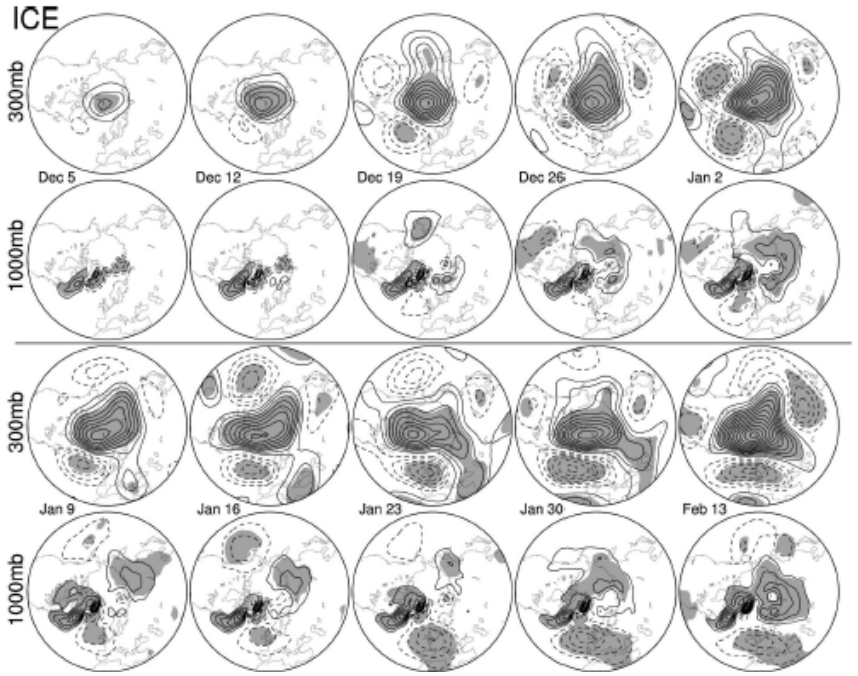
SLP JAN [CAM]



Grassi et al. (2013, JCLIM)

RECENT REVIEWS: Bader et al. 2011; Cohen et al. 2014; Vihma 2014; Walsh 2014; Gao et al. 2015; Overland et al. 2015

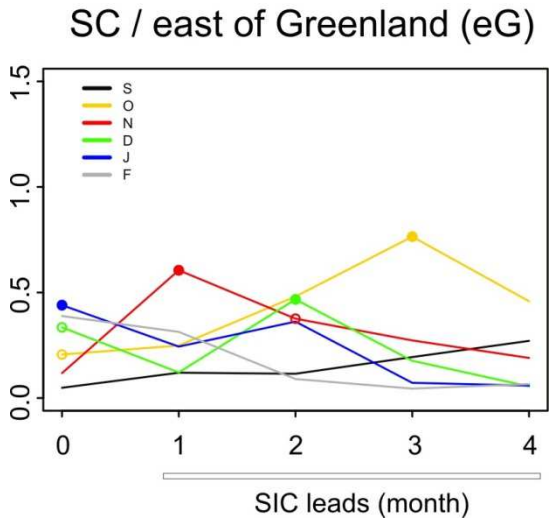




the equilibrium response to SIC reduction over G-B Seas, which projects on the negative NAO, is reached in about two months

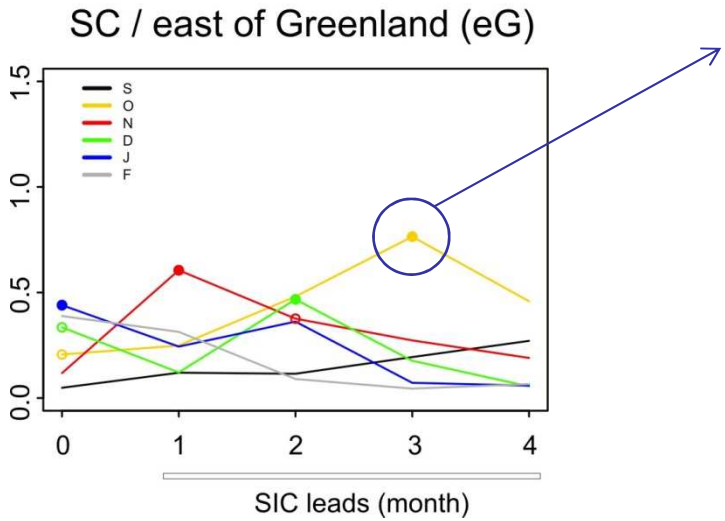
Deser et al. (2007, JCLIM)

HadISST



- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

HadISST



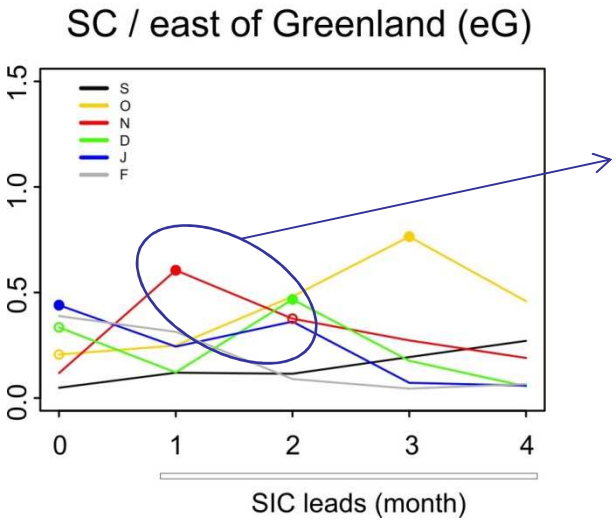
might be linked to winter blocking over Eurasia

Mori et al. 2014 (Nat.Geosci); García-Serrano et al. (2015, JCLIM)

but the lead-time is longer than the expected atmospheric response time to SIC forcing

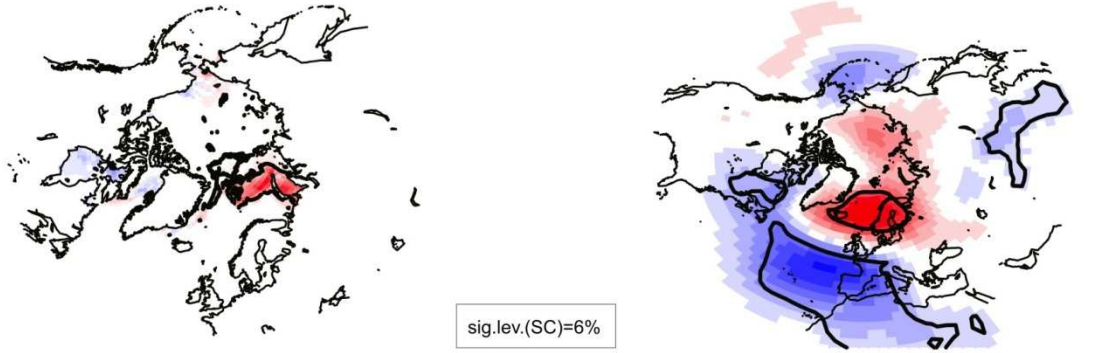
- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

HadISST



a) **MCA-SIC/eG$_{NOV}$ x SIC (nov)**

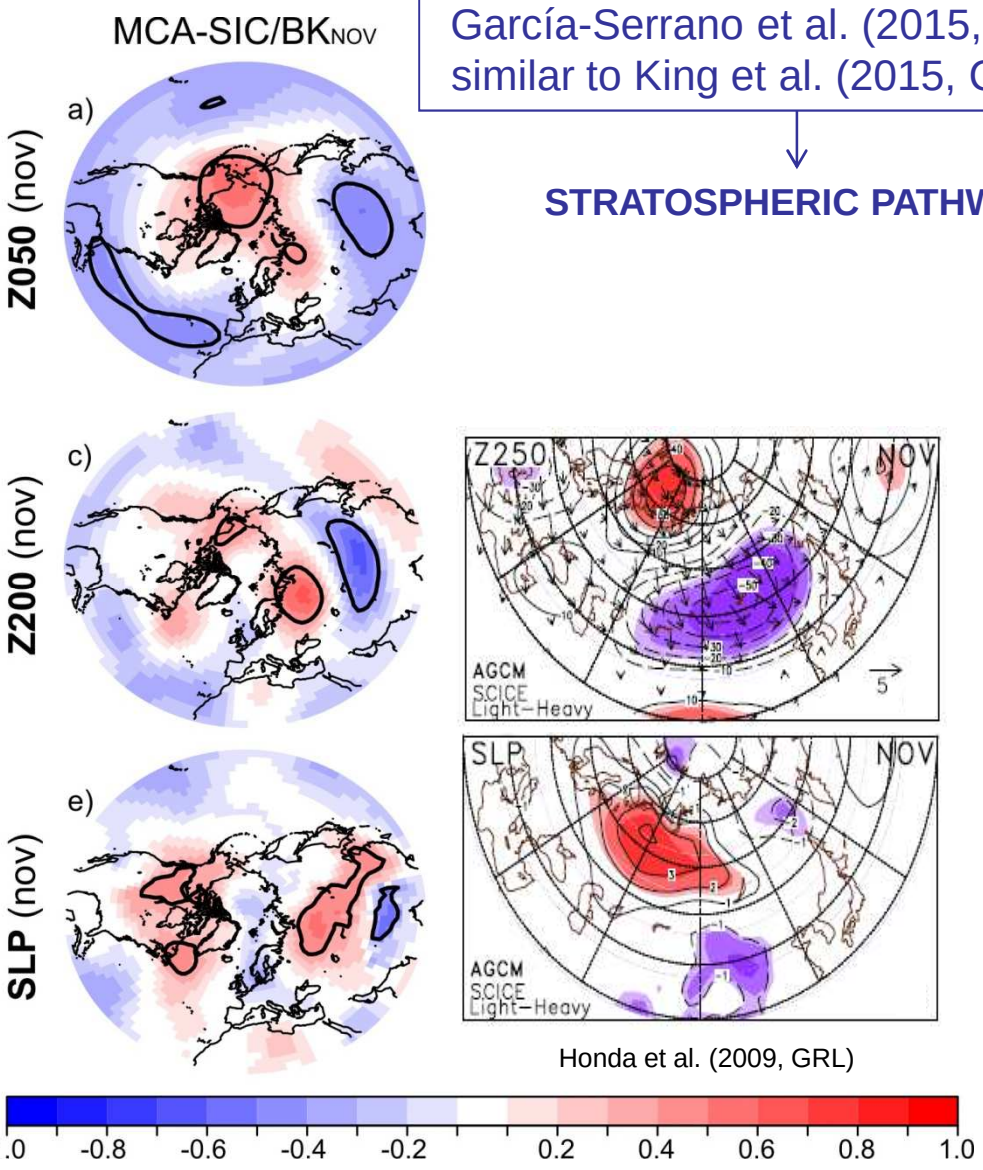
b) **MCA-SIC/eG$_{NOV}$ x SLP (jan)**



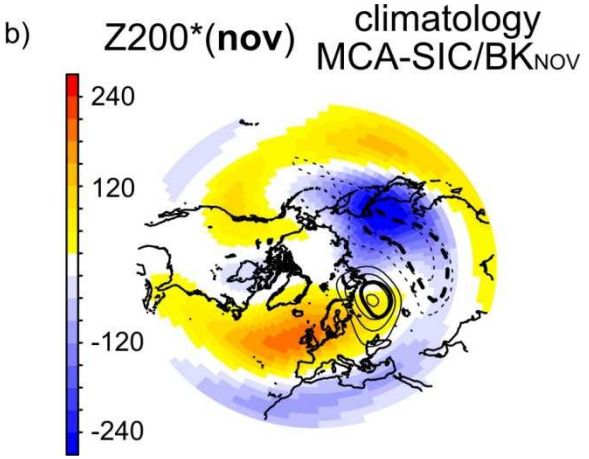
- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

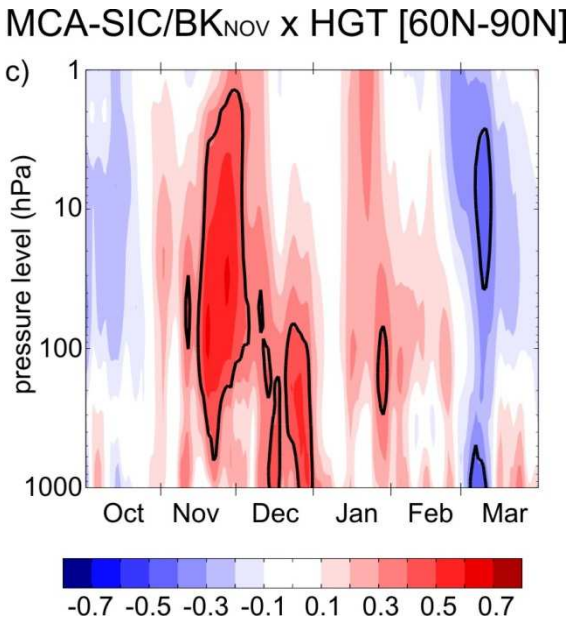
García-Serrano et al. (2015, JCLIM); similar to King et al. (2015, ClimDyn)

STRATOSPHERIC PATHWAY



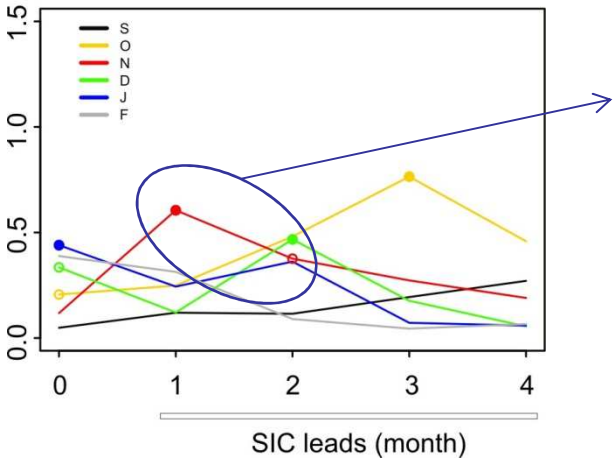
Honda et al. (2009, GRL)





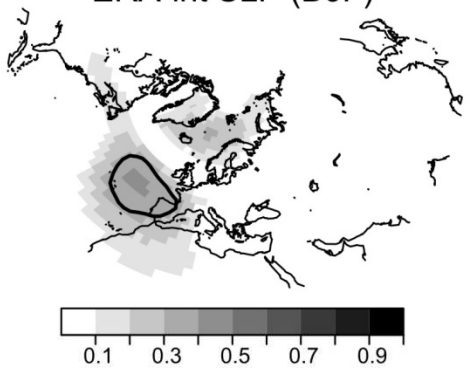
HadISST

SC / east of Greenland (eG)

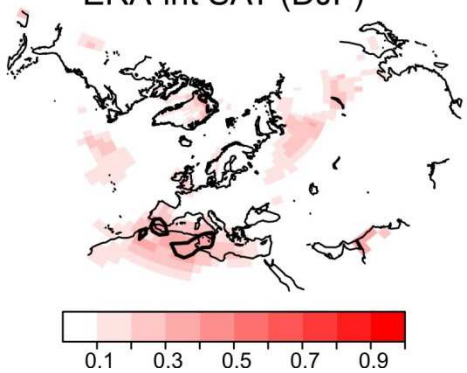


predicted by **SIC/BK**$_{Nov}$

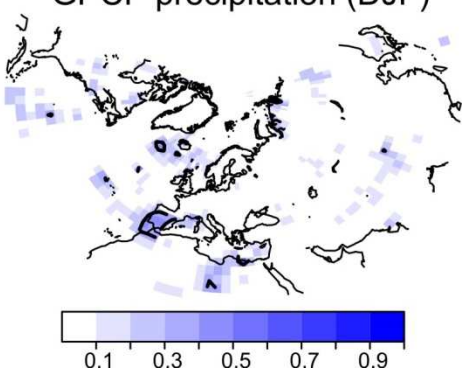
ERA-int SLP (DJF)



ERA-int SAT (DJF)



GPCP precipitation (DJF)

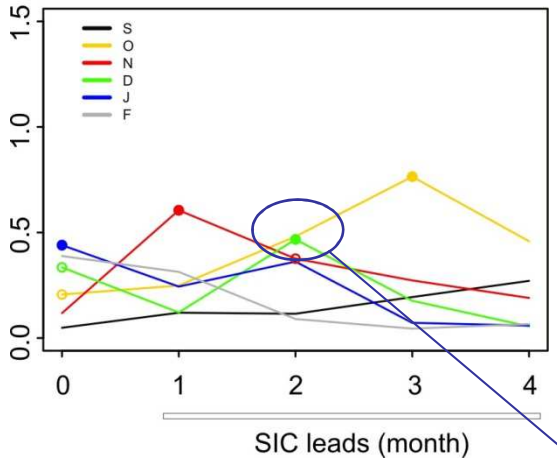


- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

García-Serrano et al. (2015, JCLIM); in agreement with Scaife et al. (2014, GRL) and Koenigk et al. (2015, ClimDyn)

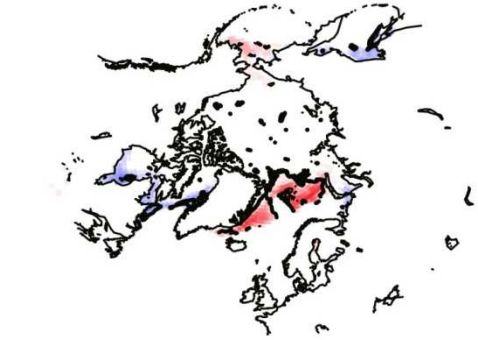
HadISST

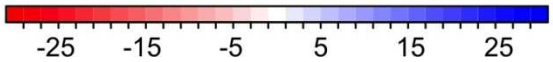
SC / east of Greenland (eG)



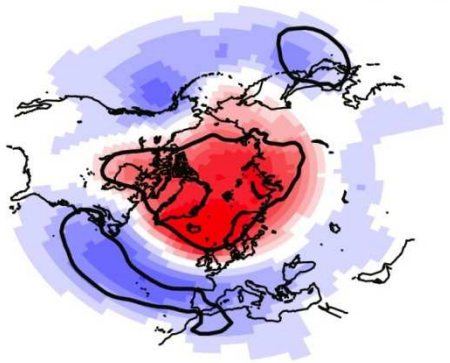
- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

c) **MCA-SIC/eG$_{DEC}$** x SIC (**dec**)

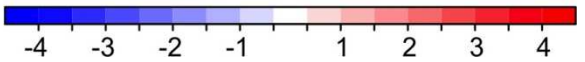


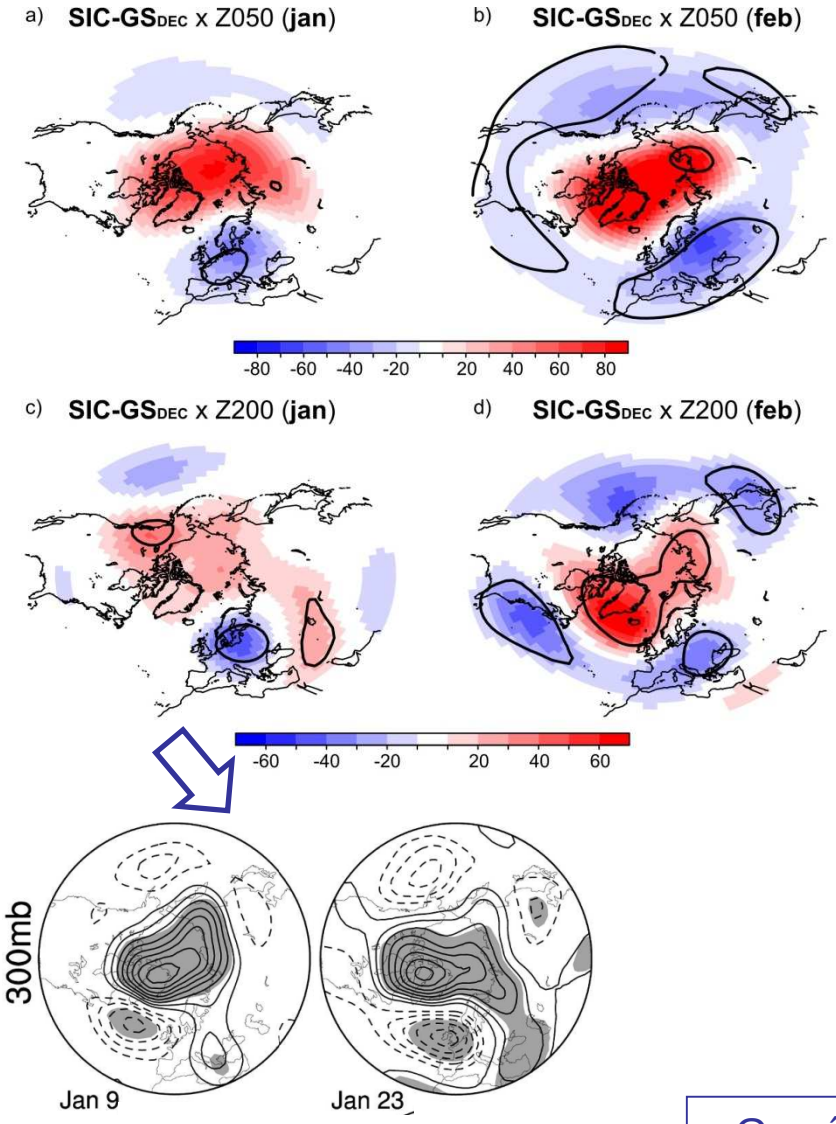


d) **MCA-SIC/eG$_{DEC}$** x SLP (**feb**)



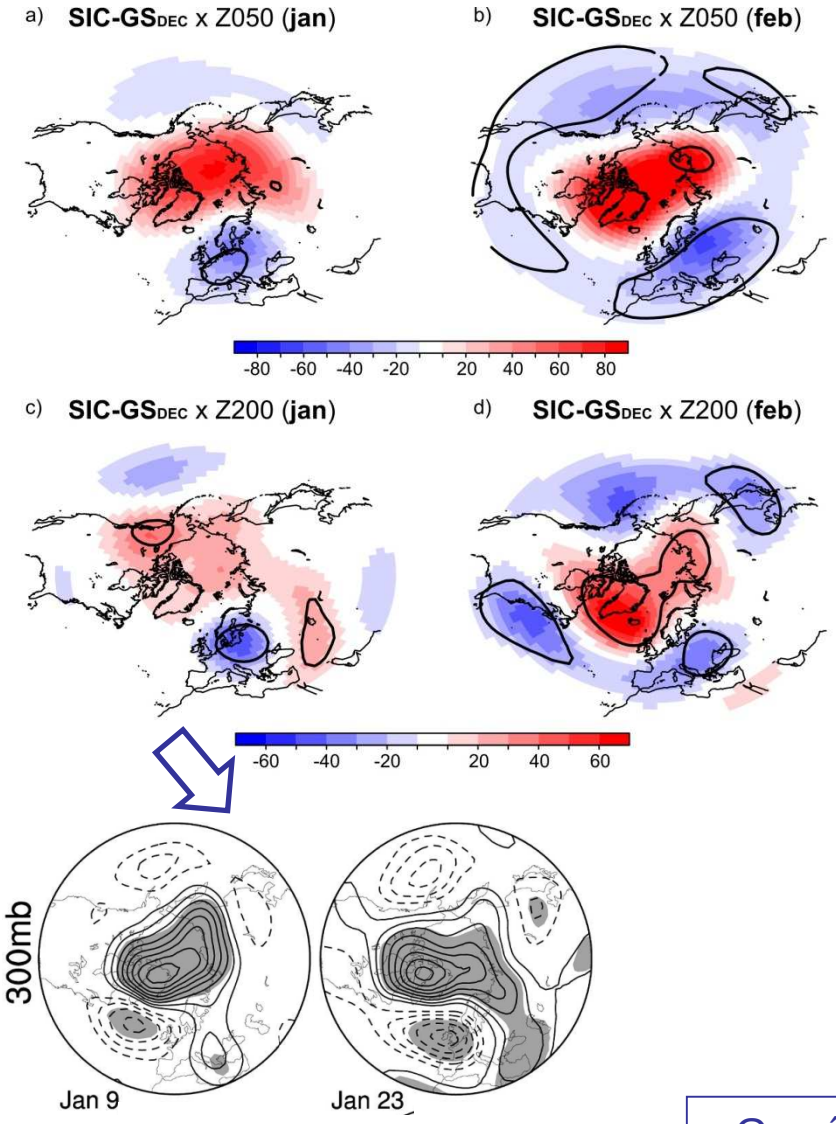
sig.lev.(SC)=0%





Deser et al. (2007, JCLIM)

García-Serrano and Frankignoul (2015, ClimDyn)



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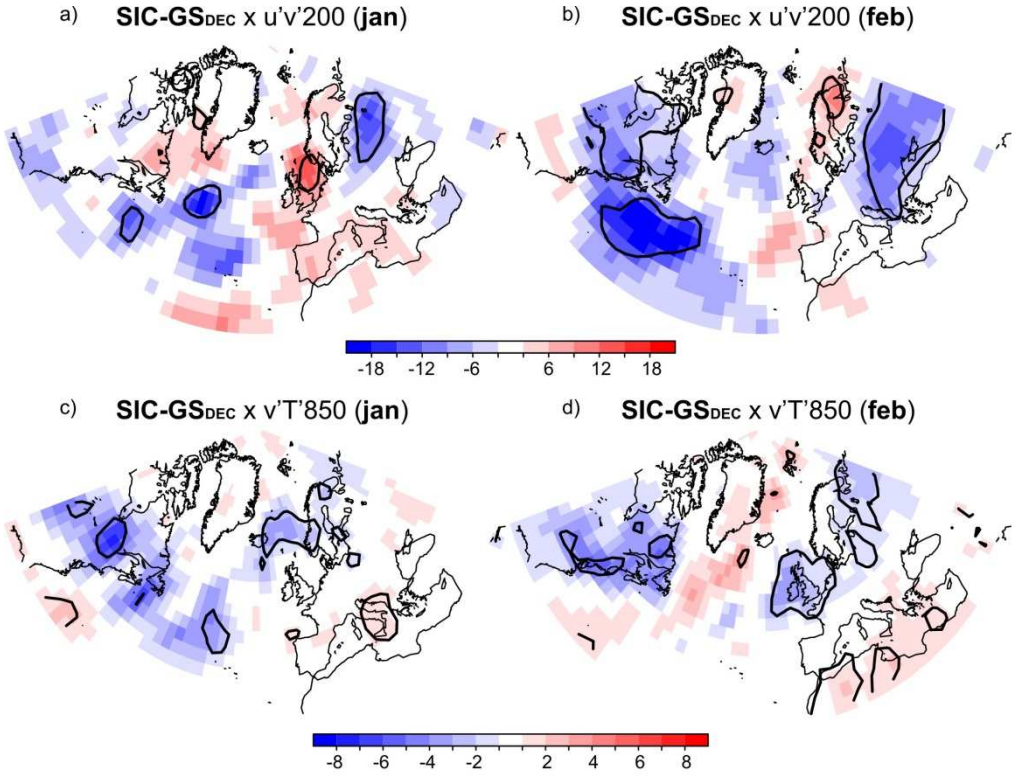
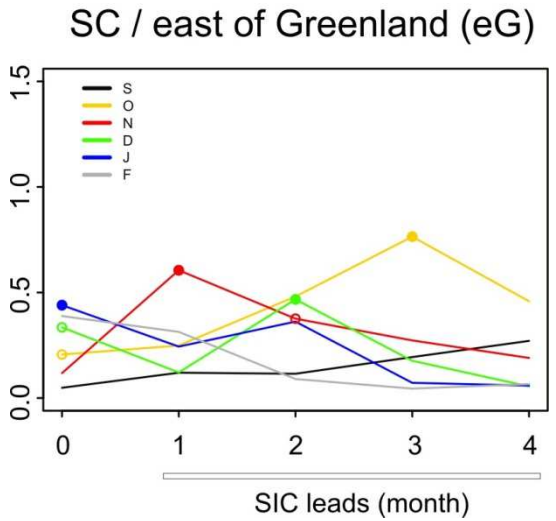


TROPOSPHERIC DYNAMICS

García-Serrano and Frankignoul (2015, ClimDyn)

HadISST

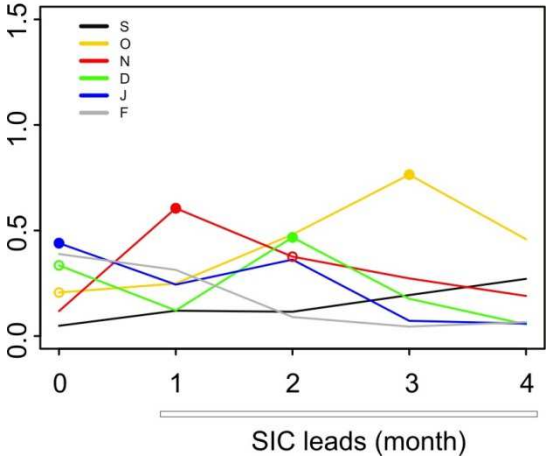


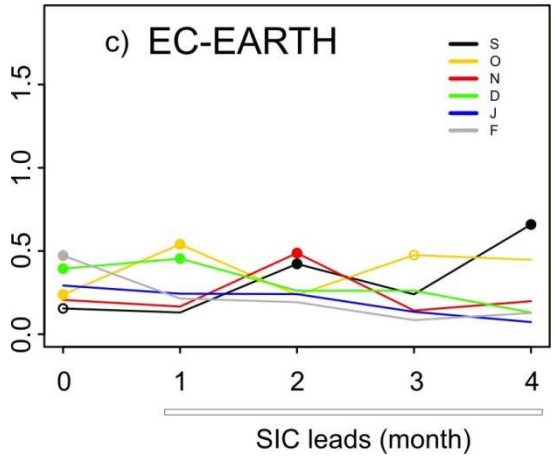
- detrended, monthly anomalies;
period 1979-2013;
target – cold season (Sep-to-Feb)

- **CMIP5**: no multi-model, each model individually;
CCSM4 (5mb), CNRM-CM5 (10mb), EC-EARTH2.3 (3mb), GFDL-CM2.1 (10mb), HadGEM2-ES (4mb), IPSL-CM5A-LR (3mb), MPI-ESM-MR (3mb), NorESM1-M (3mb) - HISTORICAL+RCP4.5 RUNS

HadISST

SC / east of Greenland (eG)





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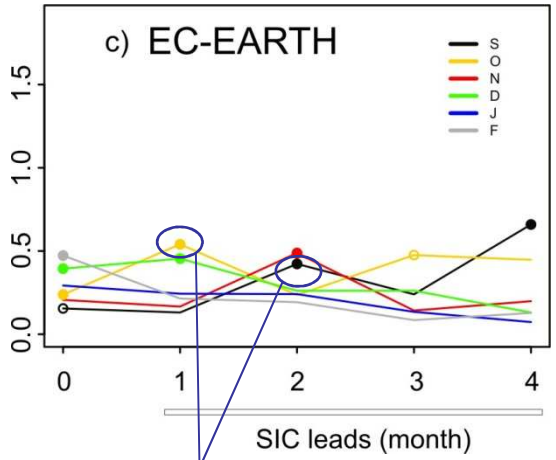
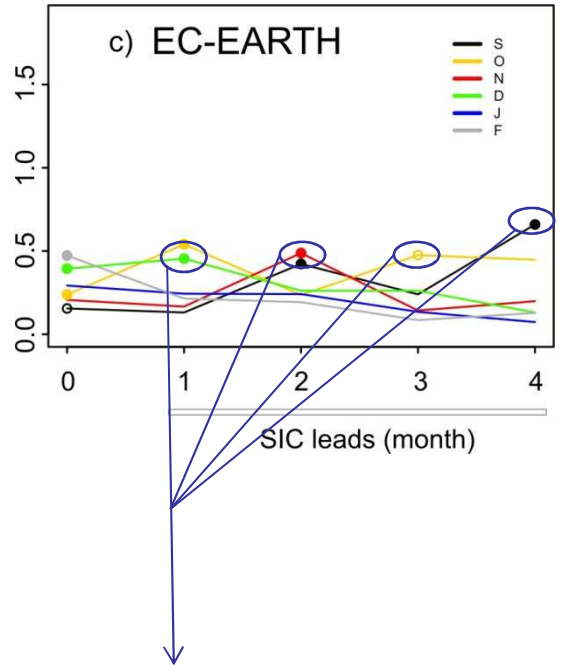


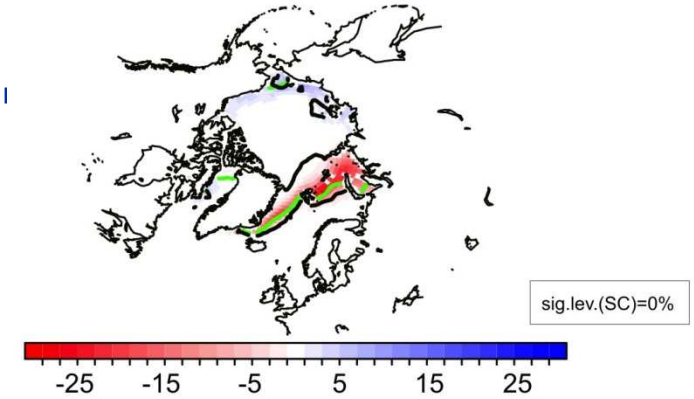
SIC persistence from Sep to Oct; sig. influence on the atm. – Nov



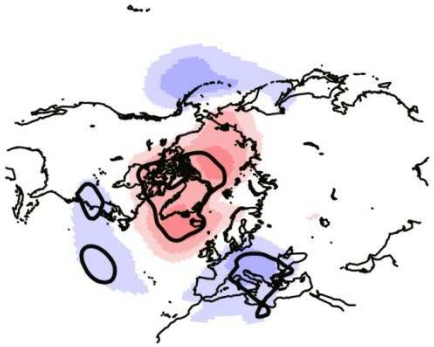
SIC persistence from Sep to Dec; sig. influence on the atm. – Jan

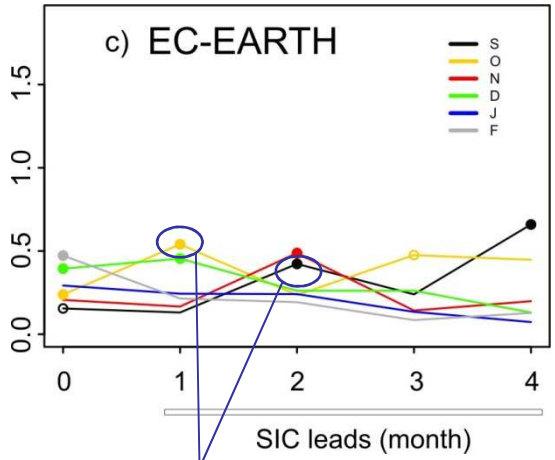
EC-EARTH

a) **MCA-SIC/eA$_{OCT}$** x SIC (**oct**)



b) **MCA-SIC/eA$_{OCT}$** x SLP (**nov**)





SIC persistence from Sep to Oct; sig. influence on the atm. – Nov

EC-EARTH

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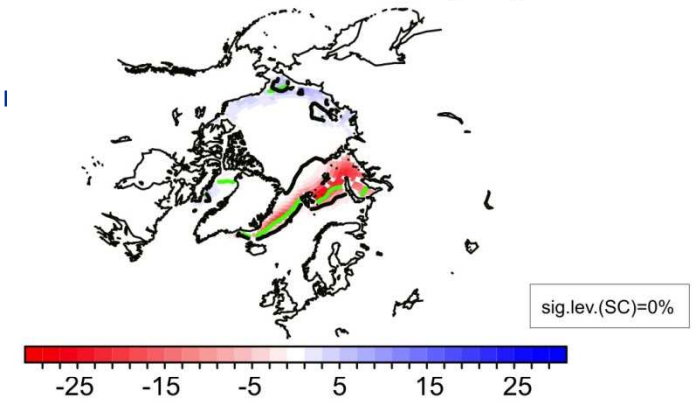
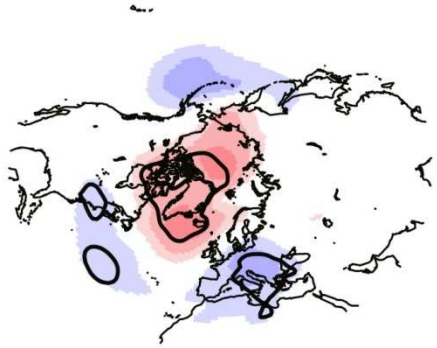
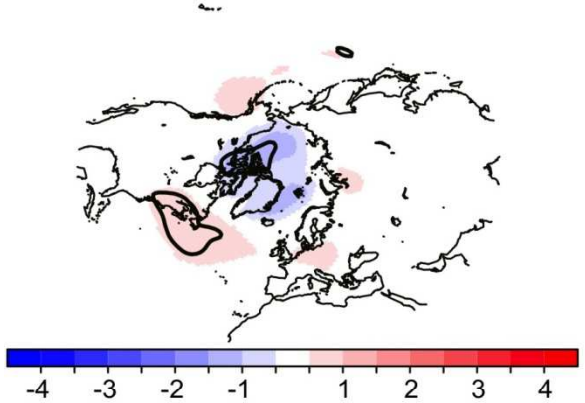


b) **MCA-SIC/eA**$_{OCT}$ x SLP (**nov**)

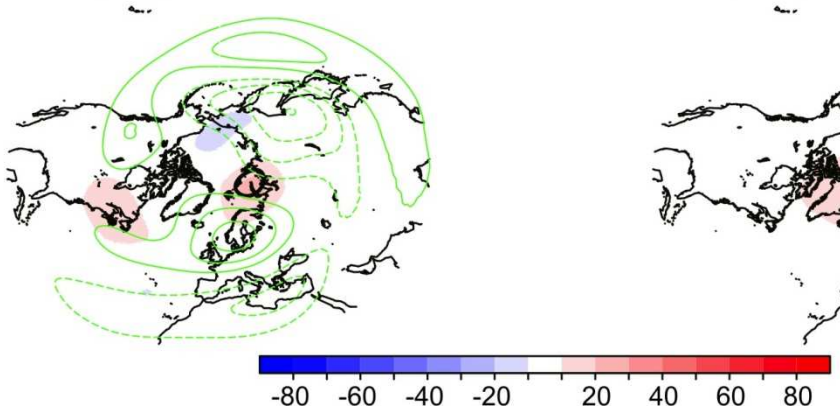


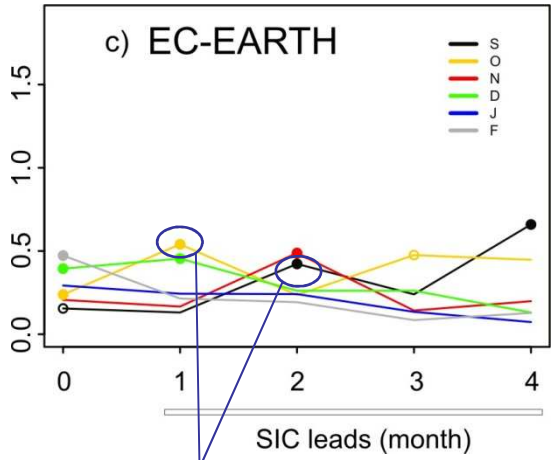
c) SLP (**oct**) x **MCA-SIC/eA**$_{OCT}$



e) Z200 (**oct**) x **MCA-SIC/eA**$_{OCT}$

f) Z050 (**oct**) x **MCA-SIC/eA**$_{OCT}$





SIC persistence from Sep to Oct; sig. influence on the atm. – Nov

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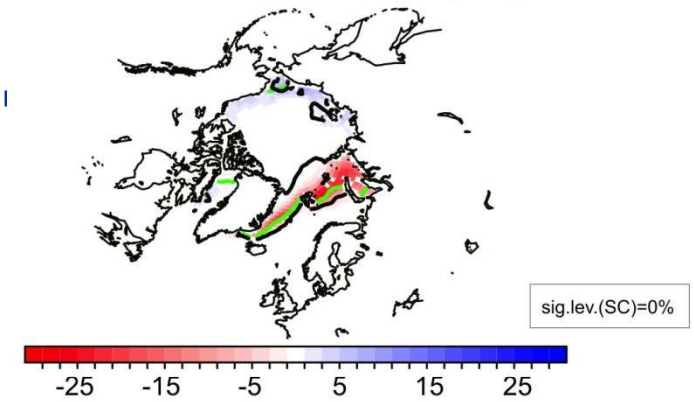
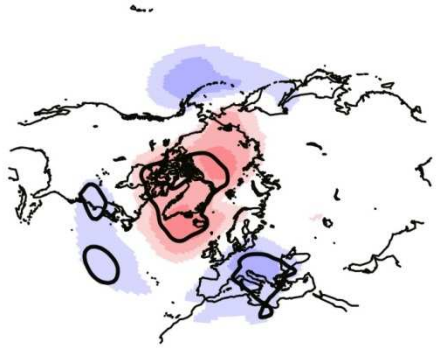
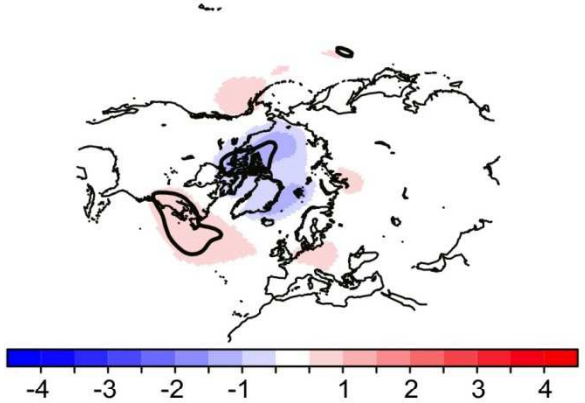


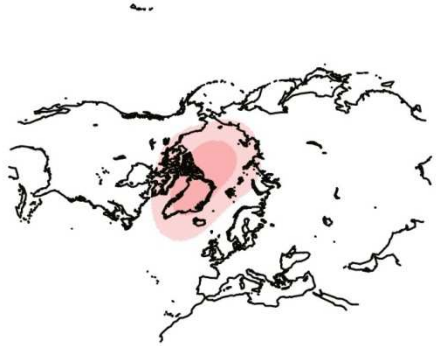
b) **MCA-SIC/eA**$_{OCT}$ x SLP (**nov**)



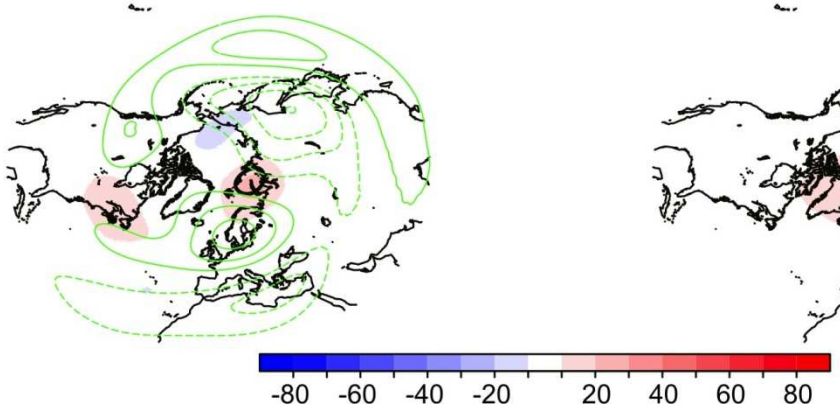
c) SLP (**oct**) x **MCA-SIC/eA**$_{OCT}$



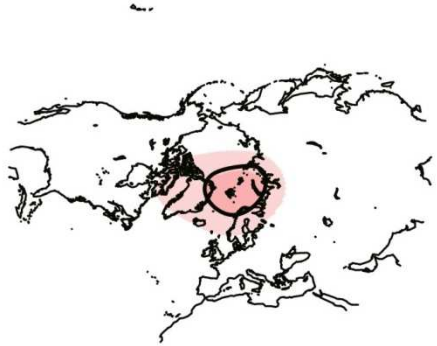
d) Z050 (**nov**) x **MCA-SIC/eA**$_{OCT}$

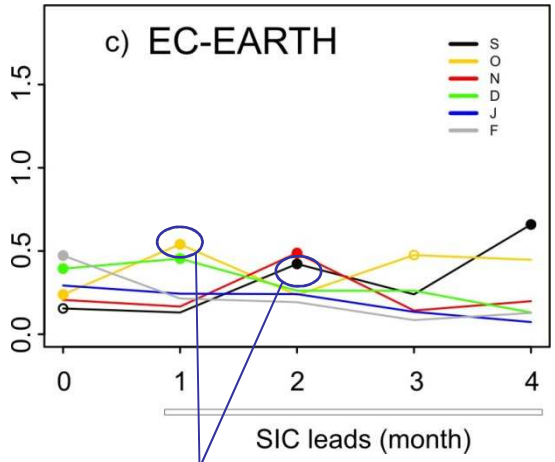


e) Z200 (**oct**) x **MCA-SIC/eA**$_{OCT}$



f) Z050 (**oct**) x **MCA-SIC/eA**$_{OCT}$

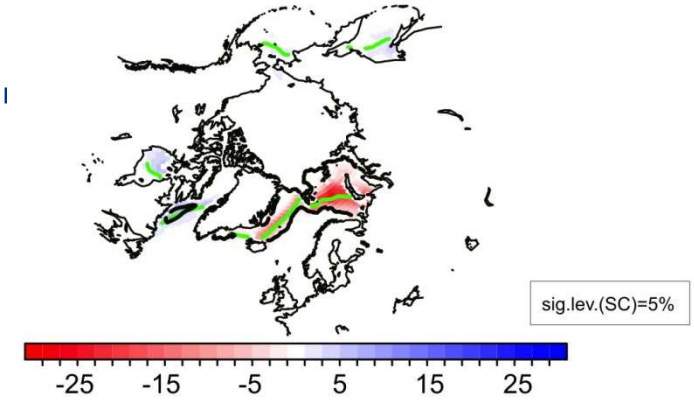




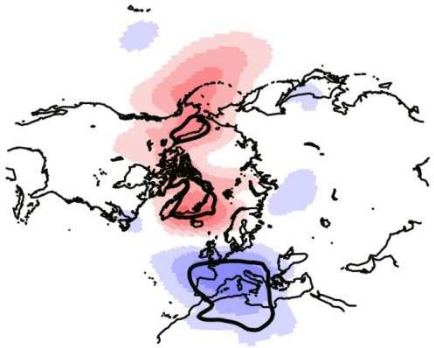
SIC persistence from Sep to Oct; sig. influence on the atm. – Nov

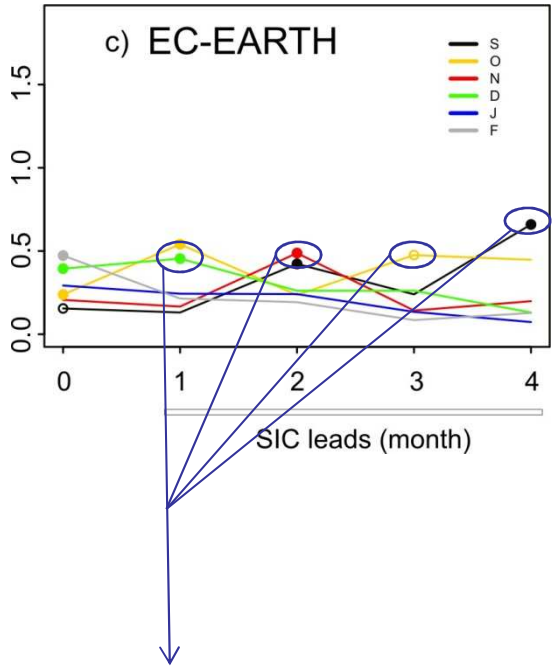
EC-EARTH

a) **MCA-SIC/eA$_{DEC}$** x SIC (**dec**)



b) **MCA-SIC/eA$_{DEC}$** x SLP (**jan**)

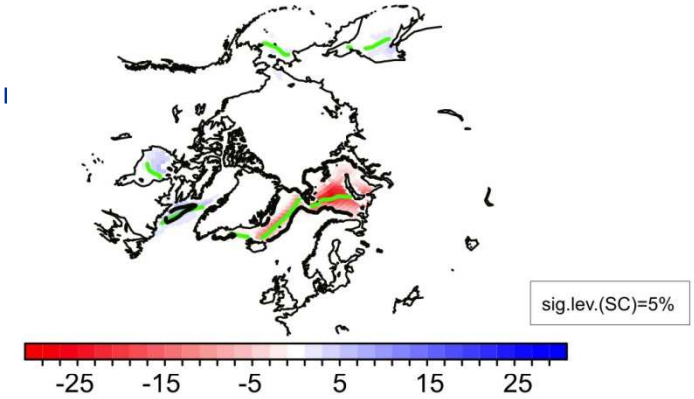




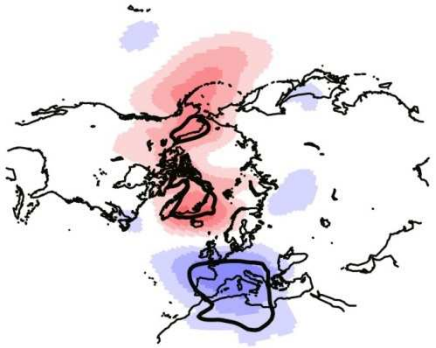
SIC persistence from Sep to Dec;
sig. influence on the atm. – Jan

EC-EARTH

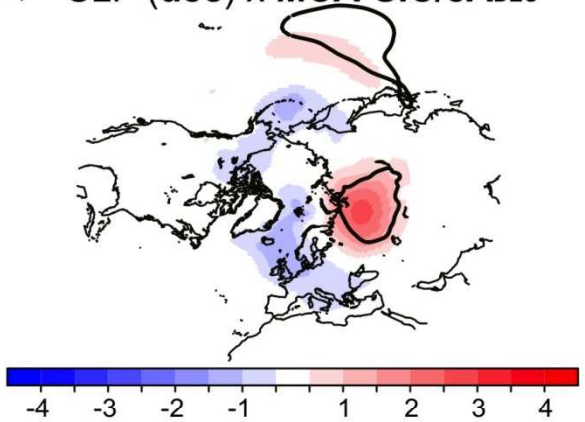
a) **MCA-SIC/eA$_{DEC}$** x SIC (**dec**)



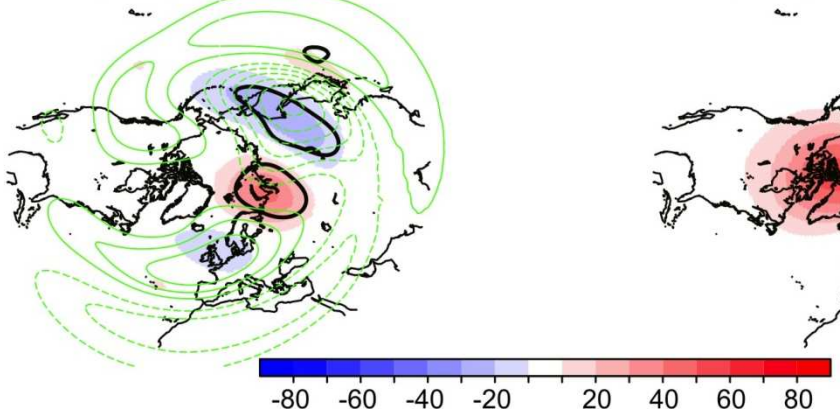
b) **MCA-SIC/eA$_{DEC}$** x SLP (**jan**)



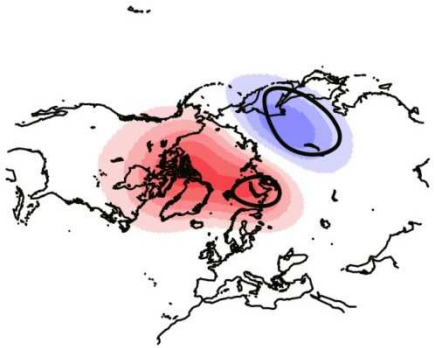
c) SLP (**dec**) x **MCA-SIC/eA$_{DEC}$**

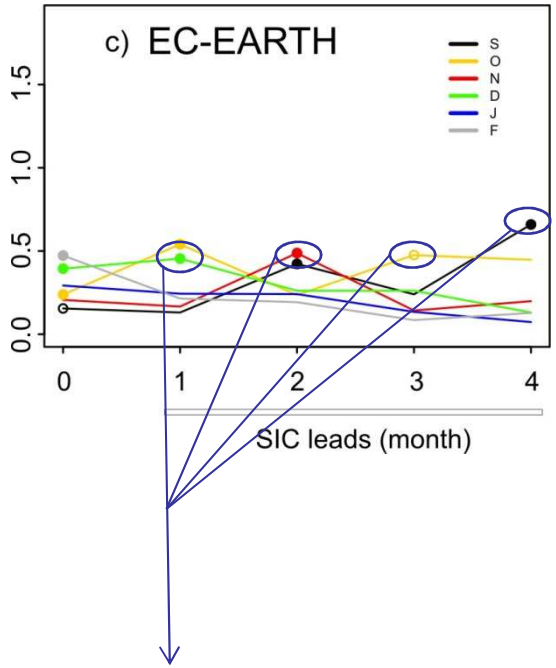


e) Z200 (**dec**) x **MCA-SIC/eA$_{DEC}$**



f) Z050 (**dec**) x **MCA-SIC/eA$_{DEC}$**

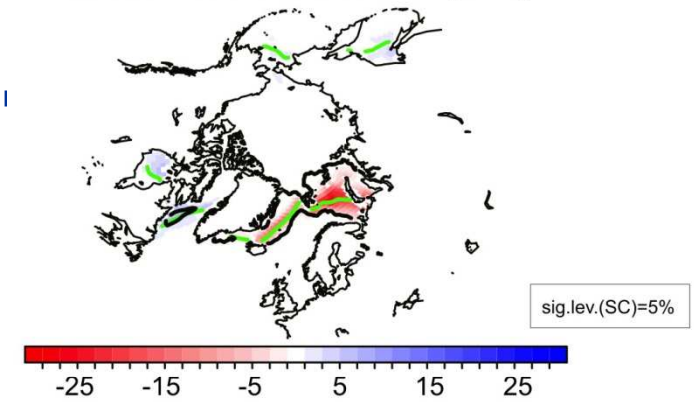




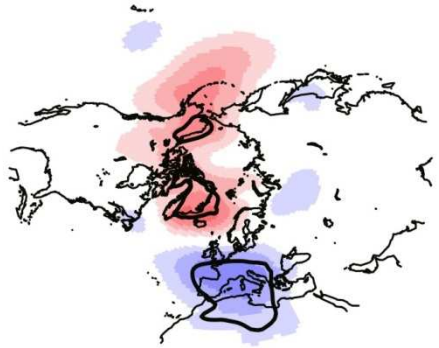
SIC persistence from Sep to Dec;
sig. influence on the atm. – Jan

EC-EARTH

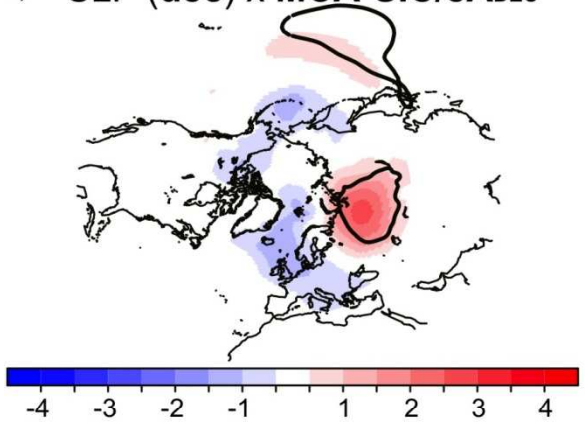
a) **MCA-SIC/eA$_{DEC}$** x SIC (**dec**)



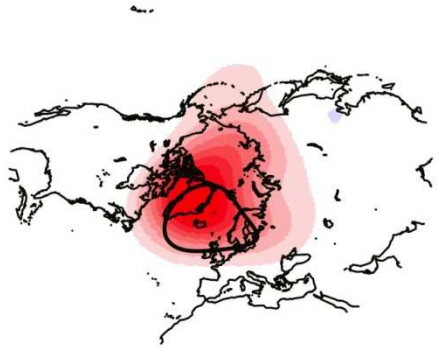
b) **MCA-SIC/eA$_{DEC}$** x SLP (**jan**)



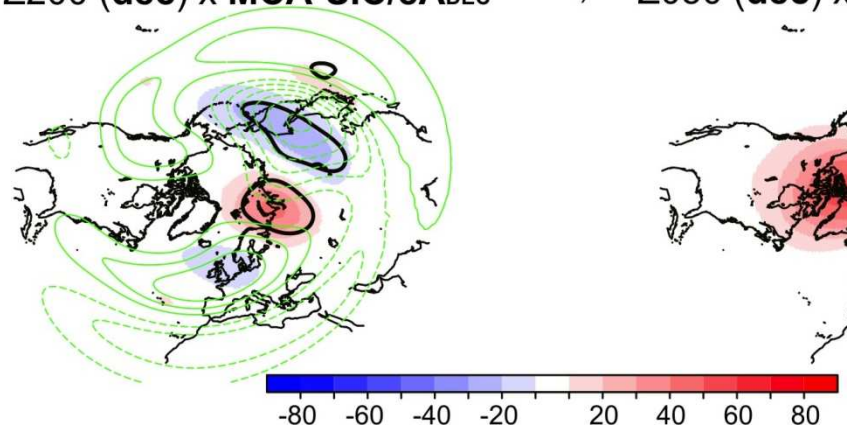
c) SLP (**dec**) x **MCA-SIC/eA$_{DEC}$**



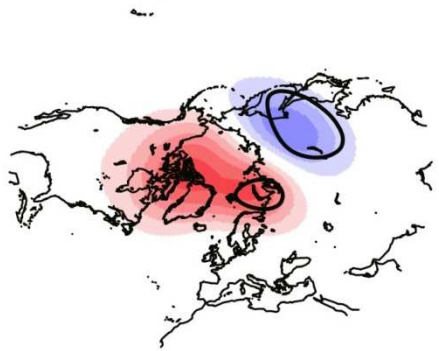
d) Z050 (**jan**) x **MCA-SIC/eA$_{DEC}$**

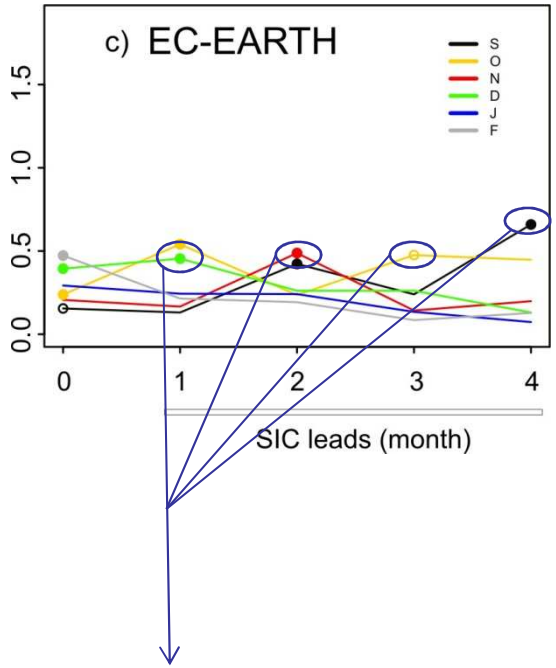


e) Z200 (**dec**) x **MCA-SIC/eA$_{DEC}$**



f) Z050 (**dec**) x **MCA-SIC/eA$_{DEC}$**





SIC persistence from Sep to Dec;
sig. influence on the atm. – Jan

SUMMARY

- CMIP5 models analysed here show a significant link with sea-ice reduction over the eastern Arctic (Greenland-Barents-Kara Seas) followed by a negative NAO-like pattern

- If the simulated relationship takes *one month* – the results suggest (in general) that a stratospheric pathway could be at play [in observations, this is shown for SIC in Nov]

- If the simulated relationship takes *two months* – the results suggest (in general) that tropospheric dynamics is dominant [in observations, this is shown for SIC in Dec]

- Target experiments are need to gain insight into the role played by the background-flow